UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE

Alaska Fisheries Science Center
Resource Assessment and Conservation
Engineering Division
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CRUISE RESULTS

CHARTERED VESSELS PAT SAN MARIE AND GOLDEN FLEECE
CRUISE NOS. 89-1
1989 WEST COAST TRIENNIAL GROUNDFISH ASSESSMENT SURVEY
JULY 7-SEPTEMBER 29, 1989

The fifth triennial comprehensive survey of west coast continental shelf groundfish resources was recently completed by the Resource Assessment and Conservation Engineering (RACE) Division of the Alaska Fisheries Science Center (AFSC). This report summarizes the preliminary results of the survey.

ITINERARY

The survey was conducted aboard the chartered commercial trawlers Pat San Marie and Golden Fleece between July 7 and September 29, 1989. On September 14 the Golden Fleece completed its portion of the triennial survey and began work on a separate survey of the upper continental slope off the Oregon coast (Golden Fleece Cruise 892). The triennial survey extended northward from Pt. Conception, California, to central Vancouver Island (Nootka Sound), British Columbia, Canada (34°30' to 49°35' N lat.). Sampling occurred at predetermined stations between 55 and 366 m in depth (30 to 200 fm) (Figure 1).

OBJECTIVES

The triennial groundfish surveys are designed to describe and monitor the distribution, abundance, and population biology parameters of various groundfish stocks off the U.S. Pacific coast. Previous surveys in this series were conducted in 1977, 1980, 1983, and 1986. The specific objectives of the 1989 survey were:

1. To describe and assess the demersal component of the Pacific whiting (Merluccius productus) resource.

2. To describe and assess the abundance of the pre-recruit component of sablefish (Anoplopoma fimbria), specifically those 1.5 years old because the abundance of pre-recruits estimated from trawl survey data has been shown to be consistent with that inferred from commercial catch levels.

3. To continue monitoring the status of other groundfish stocks.

4. To determine the biological population characteristics of key groundfish species (e.g. size composition, age composition, size at maturity, length-weight relationships, and feeding habits).

5. To continue to study the movement of juvenile sablefish through tagging.

6. To collect samples requested for special studies conducted by scientists at various fishery agencies and academic institutions.

7. To collect oceanographic data describing habitat, including sea temperature and salinity profiles.

VESSELS AND GEAR

Two commercial bottom trawlers performed the trawl operations. The Pat San Marie is 30.8 m (101 ft) in overall length and powered by a single main engine with 850 continuous horsepower. Deck equipment includes a pair of hydraulic trawl winches, 1,100 m of 2.2 cm cable per drum (1,400 m capacity), two net reels (one over the stern ramp and the other situated forward on the main deck), and two winches mounted on the boom for lifting. Electronic equipment includes 2 Loran C receivers with conversion to geodetic, a Loran C plotter, dual radars, single side band and VHF radios, paper and color video fish finders, and an auto-pilot. The Golden Fleece is 31.7 m (104 ft) in overall length and powered by twin main engines each with 624 continuous horsepower. Deck equipment includes a pair of hydraulic trawl winches with an adjustable warp tensioning system, 2,000 m of 2.54 cm cable per drum (2,800 m capacity), two net reels (one over the stern ramp, the other mounted forward on the work deck), and two winches mounted on fore and aft gantries for lifting. Electronic equipment includes two Loran C receivers with converter for geodetic positions, a Loran C plotter, dual radars, single side band and VHF radios, paper and color video fish finders, and an auto-pilot.

Both vessels used standardized Nor'eastern high opening bottom trawls equipped with roller gear. Gear specifications include: a 27.2 m headrope with twenty-one 30 cm floats and a 24.3 m long link chain fishing line attached to a 24.9 m footrope. The roller gear was 24.2 m long constructed of 2 cm diameter

galvanized wire rope, 36 cm rubber bobbins spaced 1.5 m apart and separated by a solid string of 10 cm rubber disks. Additionally, 5.9 m wire rope extensions with 10 cm and 20 cm rubber disks were used to span each lower flying wing section. Trawls were made of 12.7 cm stretched-mesh polyethylene web with a 0.6 cm mesh nylon liner in the codend. Nets were rigged with triple 54.9 m, 1.6 cm diameter galvanized wire rope dandylines. Steel V-doors (2.1 x 1.5 m) weighing approximately 567 kg each were used. The fishing dimensions of the trawl were measured aboard each vessel using a Scanmar net measurement system. Preliminary inspection of the data revealed that the net used on the Pat San Marie had a 13.4 m mean path width while that used aboard the Golden Fleece had a 12.4 m mean path width.

Oceanographic data was collected throughout the cruise. Temperature and salinity profiles of the water column were gathered using a self-contained Seabird CTD probe and sea surface temperatures were taken using bucket thermometers.

SURVEY DESIGN AND METHODS

Previous west coast triennial groundfish surveys were primarily concerned with providing distribution and abundance estimates of Pacific whiting and shelf rockfish resources, particularly canary (Sebastes pinniger) and yellowtail (S. flavidus) rockfish. Despite attempts to improve the precision of rockfish biomass estimates, variances remained high. Consequently, the 1989 survey shifted away from high density rockfish sampling and placed greater emphasis on abundance assessment of Pacific whiting and juvenile (age 1+) sablefish. The survey focused on these two species while maintaining the broader, multi-species assessment objective of previous surveys. Accordingly, a background sampling intensity comparable to the low density sampling in prior surveys was used for the entire survey area, with heavier sampling concentrated in four latitude ranges identified as high density strata for juvenile sablefish. These areas were delineated using catch rate information from previous surveys and commercial catch records. The latitude ranges of the high density strata are:

47°50'-48°20' Juan de Fuca Canyon
44°40'-46°30' Astoria Canyon
36°50'-38°00' Half Moon Bay
34°30'-35°40' Morro Bay

The normal reduction in whiting and juvenile sablefish catch rates at depths from 165 m to 183 m served as the rationale for stratification at 183 m. Thus, the shallow stratum ranged from 55 to 183 m and the deep stratum from 184 to 366 m. Tracklines were drawn across both depth strata at 18.5 km intervals. In the four high density juvenile sablefish strata, additional tracklines were drawn midway between the 18.5 km tracklines, crossing only the 55 to 183 m depth stratum. Stations were

randomly located along tracklines at the rate of one station per 7.4 km in the shallow stratum and one station per 9.3 km in the deep stratum. At least one trawl station was assigned to each depth stratum along each trackline. The two vessels fished alternate tracklines (alternate pairs in the high density areas) to minimize and to assess the effects of between vessel differences in fishing power.

A total of 601 predetermined stations were established for this survey. Tows were 30 minutes in duration, allowing 3 to 10 minutes between setting the winch brakes and beginning the tow to allow the net to settle to the bottom. Efforts were made to maintain towing at a constant depth. Catches were sorted, weighed, and counted by species; and a variety of biological data (age, length, weight, and maturity of individual specimens) was taken. Special requests were also fulfilled for meristic, stomach, fin ray, tissue, and whole fish samples.

RESULTS

Successful trawl hauls were achieved at 540 of the 555 survey stations attempted and 46 stations were abandoned where they were considered untrawlable (Figure 1, Table 1). Surface temperatures were collected at 520 stations while temperature and salinity profiles were taken at 87 of the inner- and outermost stations of the tracklines assigned to the Pat San Marie. Bottom temperatures were obtained from these profiles and are summarized by 1 degree latitudinal block in Figure 2.

A total of 122 fish species were identified in catches throughout the survey. In addition to the groundfish species, samples contained representatives from numerous orders of invertebrates. The types and numbers of biological data collected from fish are summarized in Table 2. The age structures collected will be read by the age determination unit of the AFSC.

Table 3 shows the dominant fish species caught by International North Pacific Fisheries Commission (INPFC) area and depth stratum, ranked in order of catch per unit effort (CPUE) expressed as kg/km trawled. Pacific whiting dominated the catches in all INPFC areas except Conception where it was fourth in abundance after bocaccio (Sebastes paucispinis), pacific sanddab (Citharichtys sordidus), and widow rockfish (S. entomelas); and Vancouver where it was second in abundance to spiny dogfish (Squalus acanthias). Other dominant catch components included shortbelly rockfish (S. jordani), spiny dogfish, and chilipepper (S. goodei) in the Monterey area; sablefish and jack mackerel (Trachurus symmetricus) in both the Eureka and the Columbia areas; and arrowtooth flounder (Atheresthes stomias) in both the U.S. and Canadian portions of the Vancouver area. The shallow depth stratum was typically dominated by Pacific whiting, although shallow catches in the

Conception and Vancouver areas were dominated by bocaccio and spiny dogfish, respectively. Pacific whiting was also the most dominant species in the deep stratum everywhere except the Eureka INPFC area where it was second to sablefish.

Length frequency summaries for the commercially important species are provided in Figures 3 through 6. These figures show, by INPFC area, the number of fish actually measured per sex centimeter.

A total of 138 juvenile sablefish (<40 cm) were captured in good condition, tagged, and released. This information will be incorporated into the sablefish tag release/recapture database maintained at the AFSC.

For further information contact Dr. Gary Stauffer, Director, Resource Assessment and Conservation Engineering Division, Alaska Fisheries Science Center, National Marine Fisheries Service, 7600 Sand Point Way NE., Building 4, BIN C15700, Seattle, WA 98115-0070 -- Telephone (206) 526-4170.

STAFFING FOR 1989 WEST COAST TRIENNIAL GROUNDFISH SURVEY

PAT SAN MARIE

LEG 1

DATES: JULY 13-AUGUST 2
PORTS: Morro Bay, CA-
San Francisco, CA

FPC	Mark Wilkins	AFSC
	Peter Munro	AFSC
	Dave Roetcisoender	AFSC
	Frank Morado	AFSC
	Heather Weikart	AFSC

LEG 2

DATES: AUGUST 3-23
PORTS: San Francisco, CA-
Newport, OR

FPC	Allen Shimada	AFSC
	Dan Ito	AFSC
	Therese Armetta	AFSC
	Robert Pacunski	AFSC
	Mark Wenger	AFSC

LEG 3

DATES: AUGUST 24-SEPTEMBER 13
PORTS: Newport, OR-
Westport, WA

FPC	Gary Stauffer	AFSC
	Virginia Molenaar	AFSC
	Linda Cherepow	AFSC
	Jean Rogers	OSU
	Stella Spring	AFSC

LEG 4

DATES: SEPTEMBER 14-29
PORTS: Westport, WA-
Seattle, WA

FPC	Ken Weinberg	AFSC
	Tom Dark	AFSC
	Brian Jarvis	SWFSC
	Dave Molenaar	AFSC
	Jim Nickel	AFSC

GOLDEN FLEECE

LEG 1

DATES: JULY 13-AUGUST 2
PORTS: Morro Bay, CA-
San Francisco, CA

FPC	Paul Raymore	AFSC
	Frank Shaw	AFSC
	Rebecca Hoff	AFSC
	Jeff Parkhurst	AFSC

LEG 2

DATES: AUGUST 3-23
PORTS: San Francisco, CA-
Newport, OR

FPC	Ken Weinberg	AFSC
	Stella Spring	AFSC
	Elaine Stewart	ODFW
	Sherry Wennberg	AFSC
	Casey Rice	AFSC

LEG 3

DATES: AUGUST 24-SEPTEMBER 13
PORTS: Newport, OR-
Westport, WA

FPC	Paul Raymore	AFSC
	Dave Roetcisoender	AFSC
	Claire Armistead	AFSC
	Martin Dorn	AFSC

FPC = Field Party Chief
AFSC = Alaska Fisheries Science Center
ODFW = Oregon Department of Fish and Wildlife
OSU = Oregon State University
SWFSC = Southwest Fisheries Science Center, Tiburon Laboratory

Table 1.--Successful (S), unsuccessful (U), and abandoned (A) hauls by International North Pacific Fisheries Commission (INPFC) area and depth stratum.

		Shallow (55-183 m)	Deep (184-366 m)	Total (55-366 m)
Conception area				
	S	21	9	30
	U	2	0	0
	A	0	0	0
Monterey area				
	S	108	23	131
	U	3	0	3
	A	9	10	19
Eureka area				
	S	39	16	55
	U	0	0	0
	A	0	0	0
Columbia area				
	S	164	38	202
	U	4	1	5
	A	8	0	8
U.S. Vancouver area				
	S	44	11	55
	U	0	0	0
	A	7	1	8
Canadian Vancouver area				
	S	59	8	67
	U	5	0	5
	A	14	3	17

Table 2.--Biological data collected during the 1989 West Coast triennial survey. Abbreviations: length frequency[1] (LF), age structure[2] (Age), specimen weight (Wgt), maturity (Mat), girth or width (G/W).

Species	LF	Age	Wgt	Mat	G/W	Species	LF	Age	Wgt	Mat	G/W
Pacific whiting	38,160	920	824	316	274	Brown rockfish	47	---	---	---	---
Sablefish	5,614	624	124	202	209	Canary rockfish	1,698	256	288	110	143
American shad	321	---	---	---	---	Chilipepper	6,908	---	242	---	196
Chinook salmon	14	---	---	---	---	Copper rockfish	74	---	---	---	---
Chub mackerel	130	---	---	---	---	Cowcod	22	---	---	---	---
Jack mackerel	269	---	---	---	---	Darkblotched rockfish	3,056	---	---	---	---
Lingcod	921	200	108	---	68	Flag rockfish	1	---	---	---	---
Pacific cod	---	---	---	---	92	Greenblotched rockfish	3	---	---	---	---
Pacific herring	464	---	---	---	---	Greenspotted rockfish	188	---	---	11	---
Pacific pompano	212	---	---	---	---	Greenstriped rockfish	4,349	---	98	---	---
Pacific tomcod	106	---	---	---	---	Halfbanded rockfish	108	---	---	---	---
Shiner perch	2	---	---	---	---	Pacific ocean perch	2,795	819	500	50	343
Walleye pollock	807	---	---	---	---	Pygmy rockfish	219	---	---	---	---
White croaker	595	---	---	---	---	Redbanded rockfish	56	---	14	---	---
Arrowtooth flounder	9,367	---	410	---	177	Redstripe rockfish	2,572	---	87	---	---
Butter sole	26	---	---	---	---	Rosethorn rockfish	1,115	---	55	55	---
Curlfin sole	9	---	---	---	---	Rougheye rockfish	277	---	---	---	---
Dover sole	15,997	---	401	25	360	Sharpchin rockfish	2,559	---	105	---	133
English sole	13,129	---	272	---	315	Shortbelly rockfish	3,233	290	---	50	---
Flathead sole	430	---	---	---	---	Shortspine thornyhead	1,877	---	---	---	17
Pacific halibut	299	---	---	---	---	Silvergray rockfish	349	---	---	---	---
Pacific sanddab	9,463	---	---	---	268	Speckled rockfish	5	---	---	---	---
Petrale sole	1,620	---	74	---	165	Splitnose rockfish	4,249	274	61	30	58
Rex sole	26,359	---	351	---	362	Squarespot rockfish	211	---	---	---	---
Rock sole	328	---	59	---	---	Stripetail rockfish	5,237	---	---	---	---
Sand sole	2	---	---	---	2	Vermilion rockfish	210	---	---	---	---
Slender sole	4	---	---	---	---	Widow rockfish	713	---	---	---	103
Bank rockfish	29	---	---	---	---	Yelloweye rockfish	71	---	4	---	---
Black rockfish	2	---	---	---	---	Yellowmouth rockfish	87	---	---	---	---
Blue rockfish	14	---	---	---	---	Yellowtail rockfish	1,828	464	432	109	177
Bocaccio	1,441	---	79	65	28						

[1]The number of length measurements for Pacific whiting was expanded to 38,831 by the RACE merge/adult/juvenile program.
[2]Finrays were collected from lingcod. Otoliths were collected from all other species.

Table 3.--Mean CPUE (kg/km) for the 20 most abundant groundfish species by International North Pacific Fisheries Commission (INPFC) area and depth stratum during the 1989 triennial groundfish survey.

CONCEPTION AREA 55-183 m		CONCEPTION AREA 184-366 m		CONCEPTION AREA 55-366 m	
Species	CPUE	Species	CPUE	Species	CPUE
Bocaccio	82.3	Pacific whiting	21.5	Bocaccio	41.2
Pacific sanddab	25.7	Dover sole	15.4	Pacific sanddab	12.9
Widow rockfish	22.5	Splitnose rockfish	8.7	Widow rockfish	11.3
Chilipepper	17.1	Stripetail rockfish	6.5	Pacific whiting	11.0
Squarespot rockfish	8.1	Rex sole	5.8	Chilipepper	10.7
Vermilion rockfish	4.4	Sablefish	4.6	Dover sole	8.2
Stripetail rockfish	3.8	Shortbelly rockfish	4.6	Stripetail rockfish	5.1
Pacific pompano	2.3	Chilipepper	4.4	Splitnose rockfish	4.4
Plainfin midshipman	2.1	Shortspine thornyhead	0.8	Squarespot rockfish	4.0
White croaker	1.7	Bank rockfish	0.8	Rex sole	3.3
Spiny dogfish	1.4	Surf smelt	0.7	Sablefish	2.8
Dover sole	1.1	Petrale sole	0.6	Shortbelly rockfish	2.8
Sablefish	1.0	Longnose skate	0.4	Vermilion rockfish	2.3
Shortbelly rockfish	1.0	Spotted ratfish	0.3	Pacific pompano	1.2
Pacific electric ray	0.9	Spiny dogfish	0.3	Plainfin midshipman	1.0
Petrale sole	0.7	Vermilion rockfish	0.2	White croaker	0.9
Rex sole	0.7	Pacific electric ray	0.2	Spiny dogfish	0.8
English sole	0.6	California skate	0.2	Petrale sole	0.7
Pacific whiting	0.5	Bigfin eelpout	0.2	Bank rockfish	0.6
Pink seaperch	0.5	Slender sole	0.2	Pacific electric ray	0.5
Number of hauls	21	Number of hauls	9	Number of hauls	30

MONTEREY AREA 55-183 m		MONTEREY AREA 184-366 m		MONTEREY AREA 55-366 m	
Species	CPUE	Species	CPUE	Species	CPUE
Pacific whiting	87.9	Pacific whiting	155.8	Pacific whiting	121.8
Spiny dogfish	53.6	Shortbelly rockfish	96.0	Shortbelly rockfish	50.0
Sablefish	17.3	Splitnose rockfish	23.6	Spiny dogfish	29.7
Chilipepper	16.9	Stripetail rockfish	18.5	Chilipepper	17.7
Jack mackerel	13.6	Chilipepper	18.4	Stripetail rockfish	13.8
Pacific sanddab	10.6	Dover sole	14.1	Splitnose rockfish	11.8
White croaker	9.7	Sablefish	6.2	Sablefish	11.7
Stripetail rockfish	9.0	Spiny dogfish	5.9	Dover sole	8.7
English sole	6.4	White croaker	5.7	White croaker	7.7
Shortbelly rockfish	4.1	Bocaccio	4.5	Jack mackerel	6.8
Rex sole	3.4	Rex sole	4.2	Pacific sanddab	5.5
Dover sole	3.3	Shortspine thornyhead	1.8	English sole	3.8
Pacific herring	3.3	Darkblotched rockfish	1.6	Rex sole	3.8
Lingcod	3.0	English sole	1.3	Bocaccio	3.3
Plainfin midshipman	2.5	Spotted ratfish	1.2	Pacific herring	1.6
Bocaccio	2.1	Sharpchin rockfish	1.0	Lingcod	1.6
Petrale sole	1.7	Longnose skate	0.8	Plainfin midshipman	1.3
Greenstriped rockfish	1.6	Bigfin eelpout	0.6	Spotted ratfish	1.1
Yellowtail rockfish	1.6	Pacific sanddab	0.5	Greenstriped rockfish	1.0
Widow rockfish	1.3	Greenstriped rockfish	0.4	Petrale sole	1.0
Number of hauls	108	Number of hauls	23	Number of hauls	131

EUREKA AREA 55-183 m		EUREKA AREA 184-366 m		EUREKA AREA 55-366 m	
Species	CPUE	Species	CPUE	Species	CPUE
Pacific whiting	56.2	Sablefish	47.7	Pacific whiting	45.6
Jack mackerel	42.5	Pacific whiting	35.0	Sablefish	24.5
Chub mackerel	10.9	Darkblotched rockfish	12.8	Jack mackerel	21.2
Dover sole	6.6	Dover sole	12.1	Dover sole	9.3
Widow rockfish	6.3	Splitnose rockfish	8.5	Darkblotched rockfish	6.6
Spiny dogfish	4.9	Rex sole	5.3	Chub mackerel	5.4
Stripetail rockfish	4.4	Stripetail	4.1	Splitnose rockfish	4.2
Pacific sanddab	4.2	Pacific ocean perch	3.3	Stripetail rockfish	4.2
Chinook salmon	2.4	Pacific halibut	2.6	Spiny dogfish	3.7
Rex sole	1.6	Longnose skate	2.5	Rex sole	3.5
English sole	1.3	Spiny dogfish	2.5	Widow rockfish	3.1
Longnose skate	1.3	Shortspine thornyhead	2.1	Pacific sanddab	2.1
Yellowtail rockfish	1.2	Lingcod	1.5	Longnose skate	1.9
Sablefish	1.2	Arrowtooth flounder	1.3	Pacific halibut	1.7
Lingcod	1.1	Chilipepper	0.7	Pacific ocean perch	1.6
Sharpchin rockfish	1.0	Greenstriped rockfish	0.6	Lingcod	1.3
Greenstriped rockfish	0.8	Redbanded rockfish	0.4	Chinook salmon	1.2
Pacific halibut	0.7	Eulachon	0.4	Shortspine thornyhead	1.1
Petrale sole	0.7	Spotted ratfish	0.4	Arrowtooth flounder	0.9
Eulachon	0.7	Bocaccio	0.3	Greenstriped rockfish	0.7

Table 3 (cont.)

COLUMBIA AREA 55-183 m		COLUMBIA AREA 184-366 m		COLUMBIA AREA 55-366 m	
Species	CPUE	Species	CPUE	Species	CPUE
Pacific whiting	188.5	Pacific whiting	47.7	Pacific whiting	118.1
Jack mackerel	14.2	Sablefish	13.4	Sablefish	12.3
Pacific sanddab	12.7	Canary rockfish	12.2	Jack mackerel	7.1
Sablefish	11.1	Arrowtooth flounder	5.6	Canary rockfish	6.8
Yellowtail rockfish	6.3	Pacific ocean perch	4.4	Pacific sanddab	6.3
Rex sole	5.8	Splitnose rockfish	4.4	Arrowtooth flounder	4.8
American shad	5.1	Sharpchin rockfish	4.3	Rex sole	4.2
Dover sole	5.0	Lingcod	3.2	Dover sole	4.0
Arrowtooth flounder	4.0	Dover sole	3.1	Yellowtail rockfish	3.2
English sole	3.5	Shortspine thornyhead	2.7	Sharpchin rockfish	2.9
Pacific herring	3.4	Darkblotched rockfish	2.5	American shad	2.6
Chub mackerel	3.2	Rex sole	2.5	Lingcod	2.6
Spiny dogfish	2.5	Greenstriped rockfish	1.9	Pacific ocean perch	2.3
Lingcod	2.0	Pacific halibut	1.6	Splitnose rockfish	2.2
Greenstriped rockfish	1.8	Longnose skate	1.5	English sole	1.9
Redstripe rockfish	1.7	Spotted ratfish	1.3	Greenstriped rockfish	1.8
Pacific halibut	1.6	Stripetail rockfish	0.9	Pacific herring	1.7
Sharpchin rockfish	1.6	Rosethorn rockfish	0.6	Pacific halibut	1.6
Canary rockfish	1.3	Pacific cod	0.5	Chub mackerel	1.6
Petrale sole	1.0	Chilipepper	0.4	Darkblotched rockfish	1.6
Number of hauls	164	Number of hauls	38	Number of hauls	202

US VANCOUVER AREA 55-183 m		US VANCOUVER AREA 184-366 m		US VANCOUVER AREA 55-366 m	
Species	CPUE	Species	CPUE	Species	CPUE
Bocaccio	69.8	Pacific ocean perch	38.0	Spiny dogfish	39.5
Spiny dogfish	69.4	Pacific whiting	26.5	Bocaccio	34.9
Pacific whiting	42.1	Arrowtooth flounder	21.0	Pacific whiting	34.3
Yellowtail rockfish	39.7	Walleye pollock	16.7	Arrowtooth flounder	26.4
Arrowtooth flounder	31.9	Dover sole	14.0	Yellowtail rockfish	19.9
Widow rockfish	17.0	Spiny dogfish	9.5	Pacific ocean perch	19.3
Redstripe rockfish	16.5	Sablefish	5.3	Walleye pollock	10.8
Canary rockfish	12.8	Longnose skate	3.7	Redstripe rockfish	8.9
Pacific herring	9.1	Darkblotched rockfish	3.7	Dover sole	8.6
Sablefish	5.3	Rex sole	3.4	Widow rockfish	8.5
English sole	5.1	Shortspine thornyhead	3.0	Canary rockfish	6.5
Walleye pollock	4.9	Spotted ratfish	2.3	Sablefish	5.3
Pacific halibut	4.3	Sharpchin rockfish	2.0	Pacific herring	4.5
Lingcod	3.6	Rougheye rockfish	1.7	Rex sole	2.7
Pacific sanddab	3.4	Pacific cod	1.6	English sole	2.7
Silvergray rockfish	3.3	Redstripe rockfish	1.4	Longnose skate	2.6
Dover sole	3.1	Flathead sole	1.3	Pacific halibut	2.5
Pacific tomcod	2.7	Lingcod	1.0	Spotted ratfish	2.4
Sharpchin rockfish	2.7	Pacific halibut	0.6	Sharpchin rockfish	2.4
Spotted ratfish	2.6	Greenstriped rockfish	0.5	Lingcod	2.3
Number of hauls	44	Number of hauls	11	Number of hauls	55

CANADIAN VANCOUVER AREA 55-183 m		CANADIAN VANCOUVER AREA 184-366 m		CANADIAN VANCOUVER AREA 55-366 m	
Species	CPUE	Species	CPUE	Species	CPUE
Spiny dogfish	233.4	Pacific whiting	296.1	Spiny dogfish	152.7
Arrowtooth flounder	59.0	Pacific ocean perch	98.7	Pacific whiting	151.9
Lingcod	15.0	Spiny dogfish	71.9	Arrowtooth flounder	61.9
Sablefish	14.2	Arrowtooth flounder	64.7	Pacific ocean perch	49.6
Dover sole	12.9	Sharpchin rockfish	61.0	Sharpchin rockfish	31.1
Pacific herring	12.6	Walleye pollock	30.0	Walleye pollock	17.0
Pacific cod	10.0	Dover sole	17.6	Dover sole	15.2
Redstripe rockfish	9.8	Silvergray rockfish	16.4	Sablefish	15.1
Canary rockfish	8.9	Sablefish	16.0	Redstripe rockfish	11.2
Pacific whiting	7.7	Splitnose rockfish	14.7	Lingcod	10.7
Rex sole	6.5	Redstripe rockfish	12.6	Silvergray rockfish	9.5
Yellowtail rockfish	5.0	Pacific halibut	10.1	Splitnose rockfish	7.4
Walleye pollock	4.1	Spotted ratfish	10.0	Pacific halibut	6.9
Pacific halibut	3.7	Lingcod	6.4	Pacific cod	6.8
Silvergray rockfish	2.6	Longnose skate	5.1	Pacific herring	6.3
English sole	2.6	Rex sole	4.9	Spotted ratfish	5.9
Pacific sanddab	2.4	Pacific cod	3.6	Rex sole	5.7
Bocaccio	2.1	Rosethorn rockfish	2.2	Canary rockfish	5.1
Greenstriped rockfish	2.1	Redbanded rockfish	2.1	Longnose skate	3.5
Longnose skate	1.8	Shortspine thornyhead	1.6	Yellowtail rockfish	2.5
Number of hauls	59	Number of hauls	8	Number of hauls	67

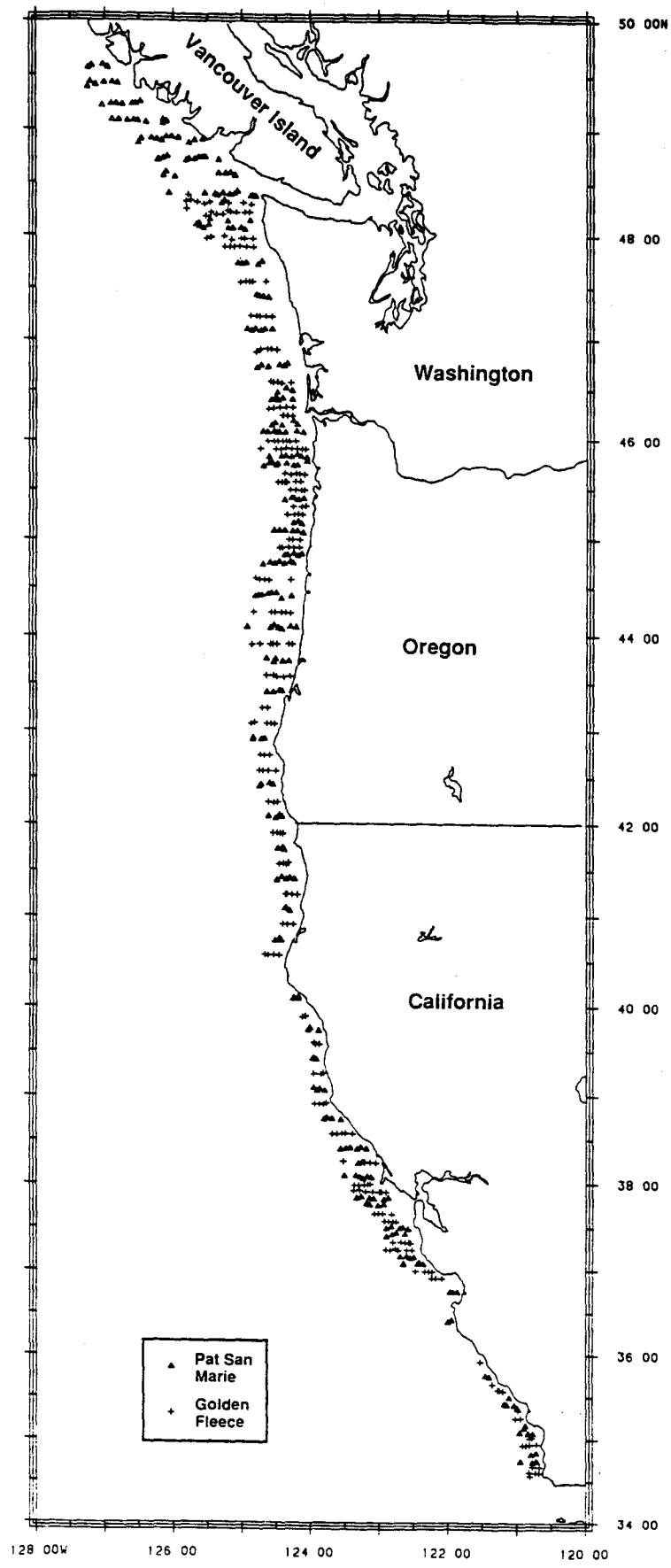

Figure 1.-- The distribution of successful trawl hauls by vessel.

Bottom temperature

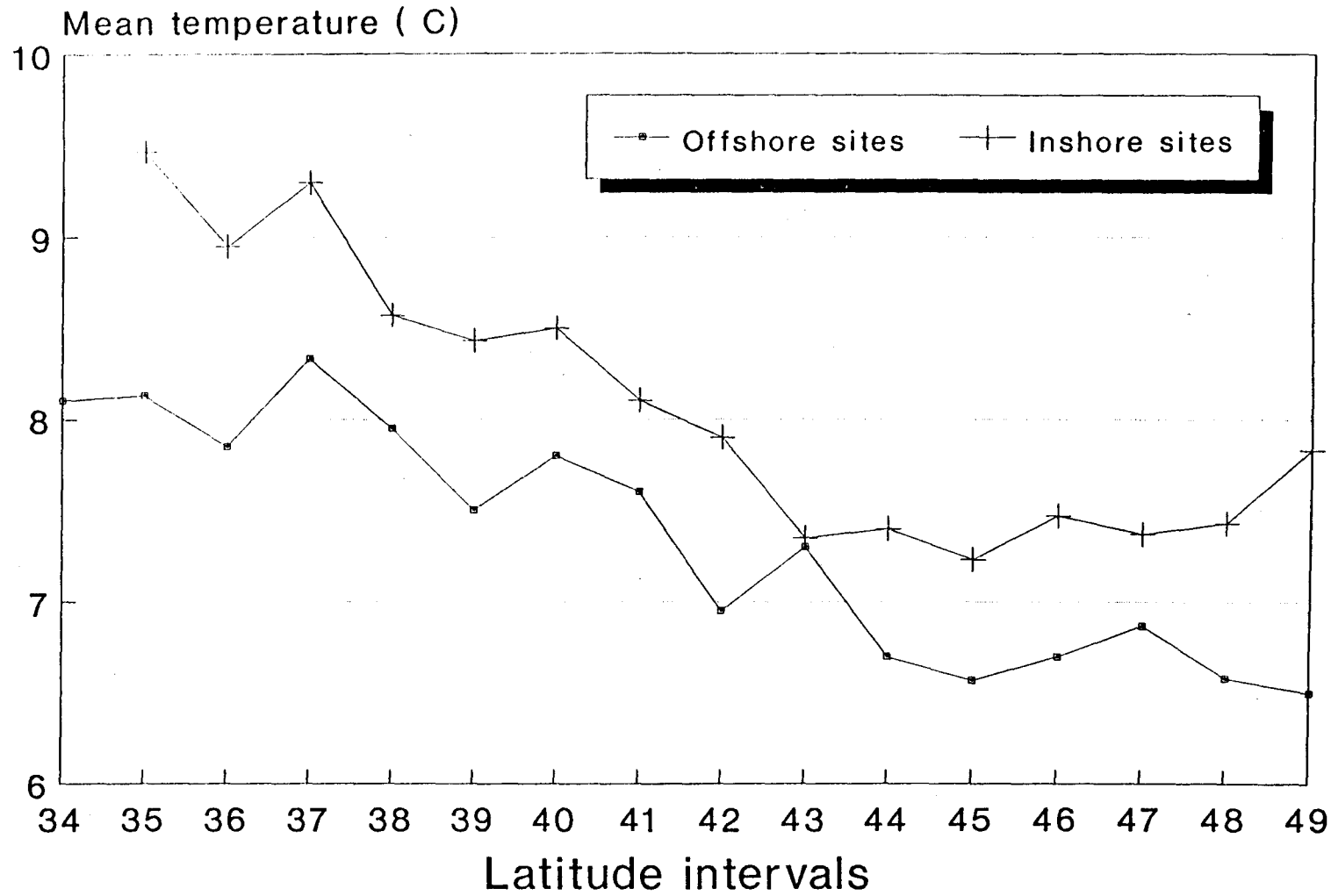

Figure 2.-- Average bottom temperatures by latitude from inshore and offshore sites taken during the 1989 triennial survey.

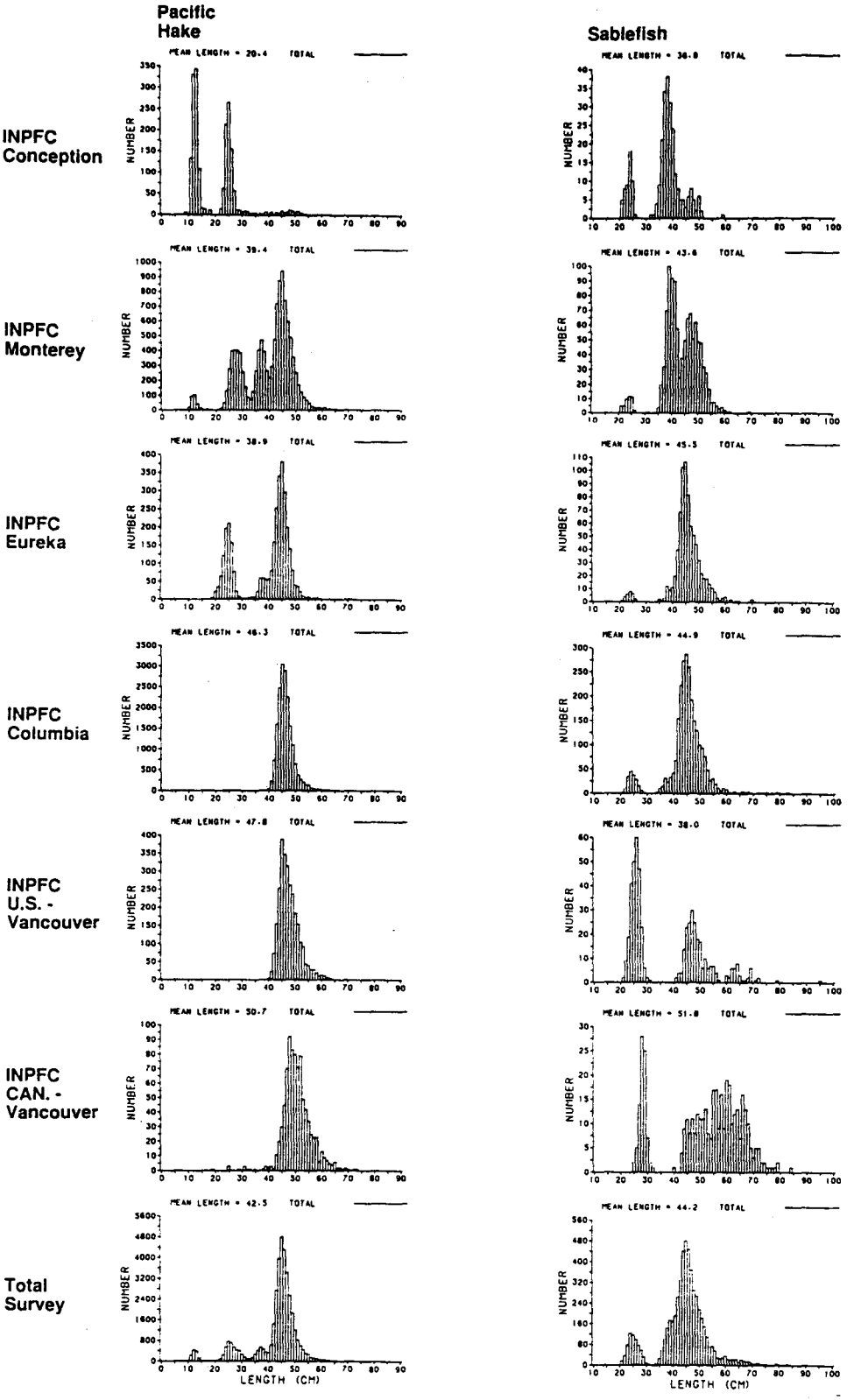

Figure 3.-- The unweighted size compositions for Pacific hake and sablefish by area.

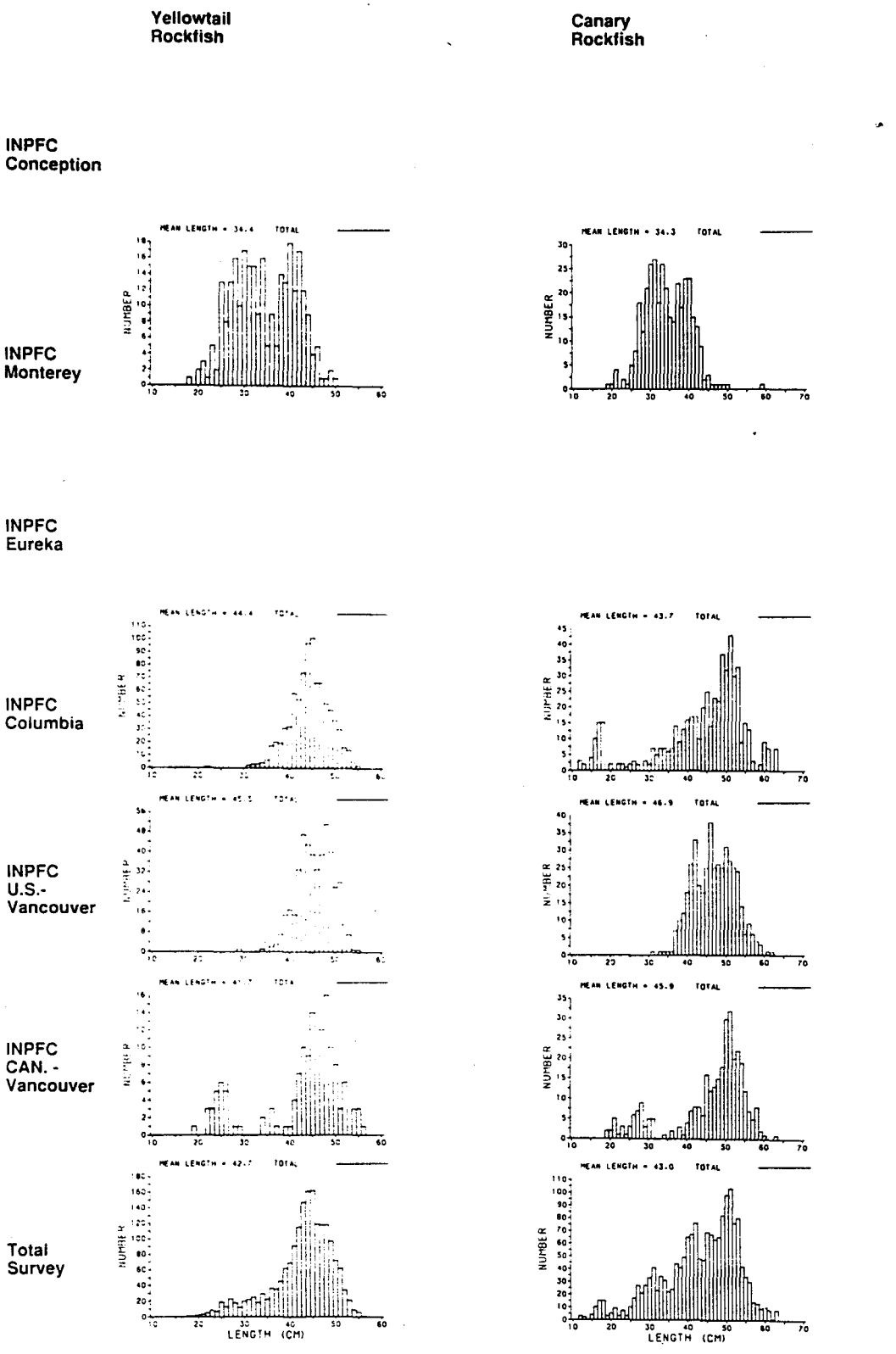

Figure 4.-- The unweighted size compositions for yellowtail and canary rockfish by area.

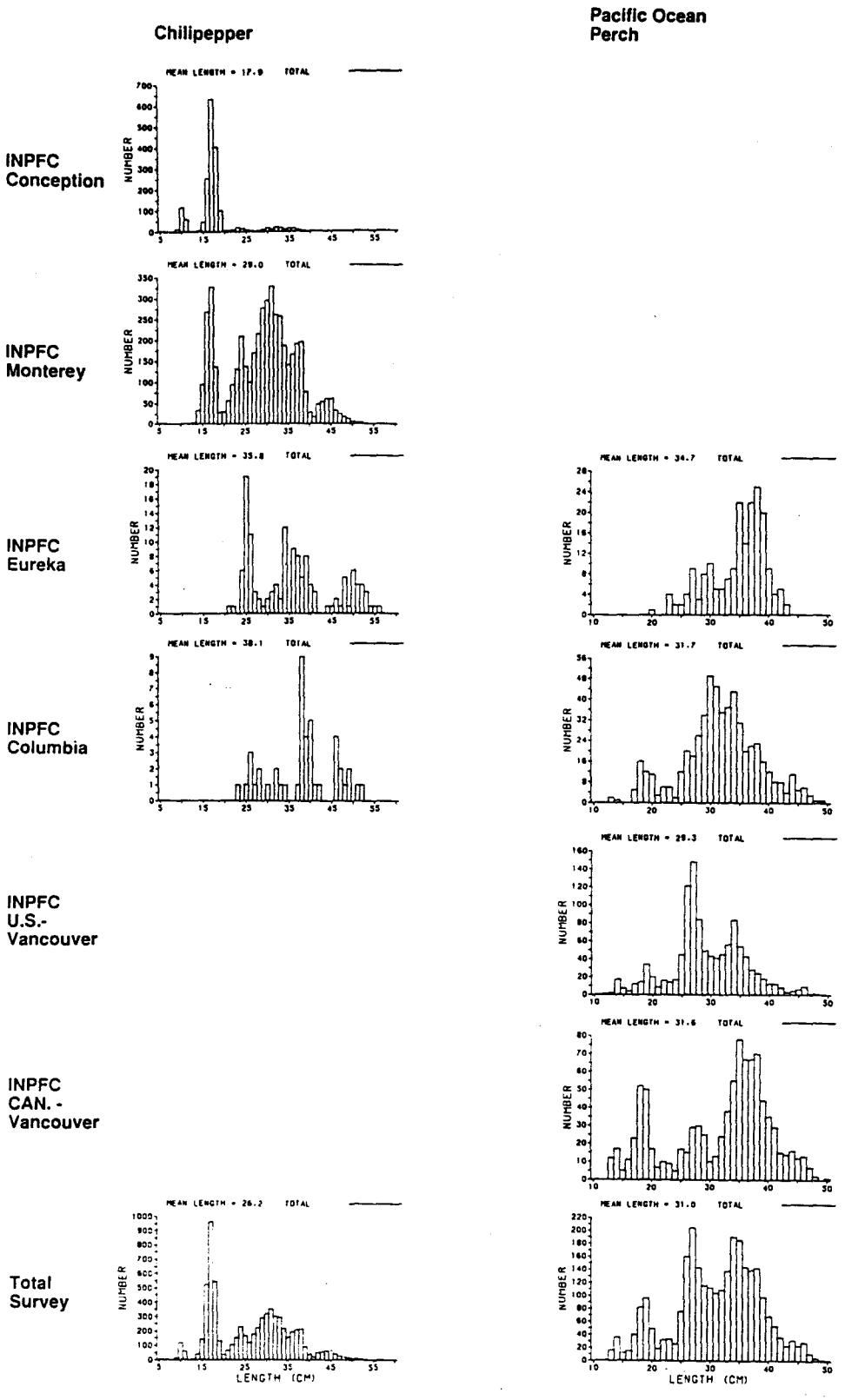

Figure 5.-- The unweighted size compositions for chilipepper and Pacific ocean perch by area.

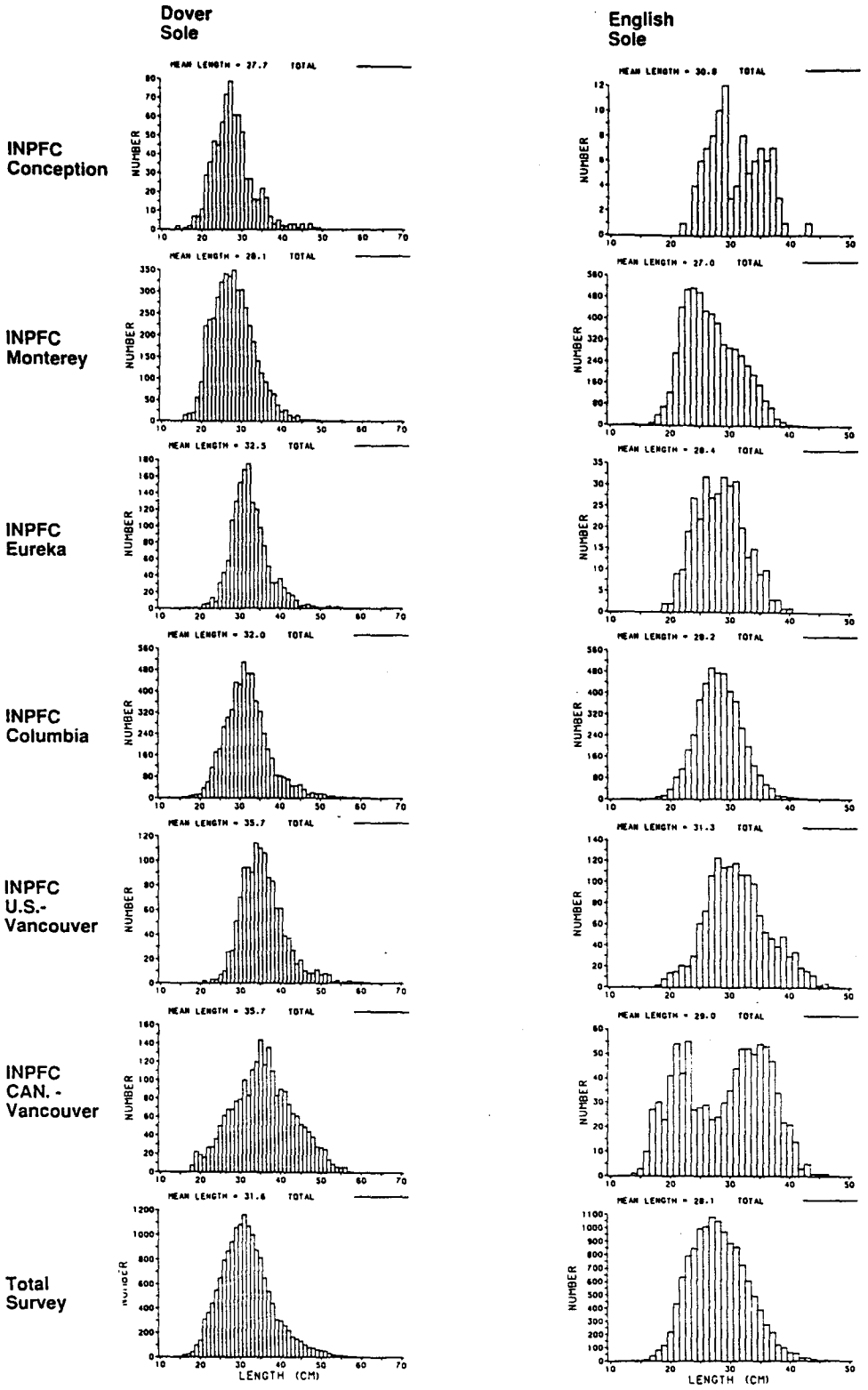

Figure 6.-- The unweighted size compositions for Dover and English sole by area.